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Multi-parametric observation of volcanic lightning produced by ash-rich plumes at Sakurajima volcano, Japan.

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Ash-rich volcanic plumes are very often associated with electrical discharges producing a majestic display of volcanic lightning.
While the direct threat posed by volcanic lightning is small in comparison to other hazards, observation and understanding of this phenomenon can shed light on important properties of the plume such as mass eruption rate and content of fine particles as recently demonstrated by laboratory investigation of volcanic lightning (Cimarelli et al., 2014). Electrical charging of ash particles within the plume can in addition play an important role in aggregation processes therefore influencing the dispersion and sedimentation of tephra. Despite the recent advances in the experimental investigations under controlled conditions and the increasing detailed observation by lightning monitoring arrays, many fundamental questions about electrical discharges in volcanic plume still remain unsolved. In particular, to which extent electrical discharges in volcanic plumes are comparable to thundercloud lightning? Is the presence of hydrometeors in the plume a necessary condition for the generation of volcanic lightning? Answering these questions is vital for the thorough understanding of the electrification process and in turn it is fundamental to fully decipher what volcanic lightning can tell us about the properties of volcanic plumes. The combination of multiparametric observation of electrical activity at erupting volcanoes can undoubtedly help us answering these questions. Here we present preliminary results from a campaign of measurements conducted at Sakurajima volcano in Japan where we combined high-speed imaging with magnetotelluric and acoustic measurements of ash-rich plumes generating electrical discharges and compare our observation with maximum plume height measurement and atmospheric soundings. We invite discussions on cross-correlation of relevant monitoring techniques and possible future developments of multi-parametric arrays.

Cimarelli et al. 2014. Experimenal generation of volcanic lightning. Geology v. 42, no. 1 doi: 10.1130/G34802.1